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(54) Elastic laminates and methods of manufacturing same

(57) A method for forming an elastic laminate comprising: bonding a first nonwoven to an elastic film to form a laminate; activating the laminate to form an activated laminate; and bonding a consolidated nonwoven to the elastic film of the activated laminate to form the elastic laminate.

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Description

REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to US Provisional Application No. 60/740,036, filed November 28, 2005, which is hereby incorporated by reference.

FIELD OF INVENTION

[0002] The present invention relates generally to elastic laminates and their methods of manufacture, and, more particularly, to breathable elastic laminates having nonwoven surfaces on both sides.

BACKGROUND OF INVENTION

[0003] Breathable elastic laminates are used in the manufacture of many goods, including, for example, disposable articles such as diapers, feminine sanitary articles, and bandages. These applications require that the laminate be strong, stretchable, and soft to the touch. Improving one of these features, however, tends to diminish the others. Consequently, previously-introduced laminates tend to represent a compromise among softness, elasticity, and strength.

[0004] For example, one prior art laminate comprises an apertured elastic laminate produced by vacuum laminating a carded polypropylene nonwoven to a multilayer coextruded elastic film. The laminate is then activated in the cross direction using intermeshing gears. This construction has the advantage of a soft feel, but is limited to two layers (nonwoven and film) and lacks high peel strength.

[0005] Another prior art product comprises an apertured elastic film which is activated in the cross direction (CD) and is ultrasonically bonded on each side to a consolidated nonwoven. Although this laminate tends to be strong, it has a harsher feel than desired, requires substantial ultrasonic energy to bond the layers, and, because it has three layers, it tends to lack the level of stretch obtainable from a laminate with just a single layer of nonwoven.

[0006] Therefore, there is a need for a breathable laminate that is soft on either side yet stretchable and strong. The present invention fulfills this need among others.

SUMMARY OF INVENTION

[0007] The invention relates to an elastic laminate having soft, nonwoven surfaces on both sides, yet is stretchable and strong. Specifically, the elastic laminate comprises an elastic inner layer and two outer nonwoven layers, in which each nonwoven layer is rendered extensible through a different method. That is, one nonwoven layer is activated, while the other is consolidated.

[0008] Applicants have discovered unexpectedly that the laminate of the present invention has an exceptional degree of cross direction stretch, offers a pleasant, soft feel, and can be bonded ultrasonically at full line speed to obtain an exceptionally strong interlayer bond. Without being bound to any particular theory, applicants hypothesize that the high level of stretch results from "elasticizing" the two nonwoven layers using two different techniques-i.e., activation and consolidation. This approach synergistically combines the strengths of the two technologies, resulting in a laminate having the high tensile strength and a strong bond characteristic of a consolidated/ultrasonically bonded nonwoven, and the softness and tear resistance characteristic of an activated nonwoven. Furthermore, this approach appears to minimize the observed tendency of one nonwoven layer to constrain the extensibility of the other nonwoven layer in the same laminate.

[0009] Accordingly, one aspect of the invention is an elastic laminate having two outer nonwoven layers which are rendered extensible using two different techniques. In a preferred embodiment, the elastic laminate comprises: (1) an elastic layer having a first and second side; (2) an activated nonwoven layer bonded to the elastic layer on the first side; and (3) a consolidated nonwoven layer bonded to the elastic layer on the second side.

[0010] Another aspect of the invention is a method for producing the laminate described above. In a preferred embodiment, the method comprises: (1) bonding a first nonwoven to an elastic film to form a laminate; (2) activating the laminate to form an activated laminate; and (3) bonding a consolidated nonwoven to the elastic film of the activated laminate to form the elastic laminate.

DESCRIPTION OF DRAWINGS

[0011] Figure 1 shows a schematic view of an elastic laminate of the present invention.

[0012] Figure 2 shows a schematic of a manufacturing line for making the elastic laminate of Fig. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] The present invention relates to an elastic laminate and a method for making it. Briefly, referring to Fig. 1, the elastic laminate 10 comprises an elastic layer 12 having a first and second side, 14, and 15. Preferably, but not necessarily, the elastic layer has apertures 13 or is otherwise modified to be breathable. On the first side 14 is an activated nonwoven layer 16 bonded to the elastic film material 12. As used herein the terms "activated" or "activation" refer to a method or state in which a laminate comprising an elastic layer and at least one less-elastic layer is stretched to an extension limit beyond the deformation point of the less-elastic layer to allow the elastic layer to elongate to the extension limit essentially unimpeded by the less-elastic layer. Activation is a well-known technique. On the second side 15 is a consolidated nonwoven layer 17 bonded to the elastomer film 12.

As used herein, the terms "consolidated" or "consolidation" refer to a method or state in which the fibers or fiber-like elements of the nonwoven are aligned, thereby allowing the nonwoven to elongate in a direction perpendicular to the alignment. Consolidation, like activation, is a well-known technique for imparting extensibility to a nonwoven.

[0014] Referring to Fig. 2, the method 100 of preparing the laminate 10 is described in connection with a preferred manufacturing apparatus. The method comprises bonding a first nonwoven 50 to an elastic film 60 to form a laminate 65. The elastic film is optionally breathable. Once the laminate 65 is formed, it is activated to form an activated laminate 75. A consolidated nonwoven 55 is then bonded to the elastic film 50 of the activated laminate 75 to form the elastic laminate 95. The elastic laminate 95, its uses, and the method of preparing it are described in detail below.

[0015] Referring back to Fig. 1, the elastic layer 12 provides elasticity to the laminate. The elastic layer comprises at least one elastic material. Suitable elastic materials include any material that is capable of being formed into a thin sheet, rendered breathable and bonded to nonwovens. For example, elastic materials include natural and/or synthetic polymeric materials including isoprenes, butadiene-styrene materials, styrene block copolymers (e.g., styrene/isoprene/styrene (SIS), styrene/butadiene/styrene (SBS), or styrene/ethylene-butadiene/styrene (SEBS)), olefinic elastomers, polyether esters, polyurethanes, etc. In certain preferred embodiments, the elastic materials may comprise high performance elastic material such as Kraton® elastic resins from Kraton Polymers, LLC, which are elastic block copolymers.

[0016] The form of an elastic layer 12 can vary and may include, for example, elastic strands, elastic nonwoven, elastic film, elastic adhesive, elastic tacky polymeric web, elastic scrim, etc. For the sake of simplicity, unless otherwise noted, these different forms are referred to collectively herein as "elastic film." In certain preferred embodiments, a monolayer elastic film is used. It should be understood, however, that the present invention in not limited to a monolayer film and, in certain applications, a film having multiple layers may be used. For example, it may be advantageous to have an elastic core between two skin layers to enhance bonding to the nonwoven layers or to facilitate processability. Suitable skin layers are well known and include, for example, polyethylene which may be more or less elastic than the elastic material. The thickness of the elastic film may vary according to the application, although the individual layers of the films are typically thin (e.g., the elastic core is usually, but not necessarily, less than 100 microns, and skin layers, if used, are usually less than 20 microns).

[0017] Preferably, the elastic film is breathable or is modified to be breathable in conventional ways. Such ways include, for example, aperturing, slitting, or impregnating with granular particles to create microvoids upon stretching of the elastic film.

[0018] The first nonwoven layer 16 provides a soft and breathable surface once activated (discussed below) on the first side 14 of the elastic layer. Suitable nonwovens are capable of being activated and are less elastic than the elastic layer 12. Suitable nonwovens include loose fibers and webs prepared using know techniques such as, for example, air laying, spun bond, spun lace, bonded melt blown, thermobond, bonded carded. The nonwoven material may be homogeneous or contain a variety of woven materials including bi-component fibers (e.g. having an inner core of one material and an outer core of a second material), fibers of different morphologies, geometries, and surface finishes. Suitable nonwovens materials include, for example, fibrous polyolefins such as polyethylenes and polypropylenes, and natural fibers such as cotton and cellulose.

[0019] The consolidated nonwoven 17, like the first nonwoven 16, provides a soft and breathable covering to the second side 15 of the elastic layer 12. Unlike the first nonwoven, the consolidated nonwoven is rendered extensible through a consolidation method rather than an activation method. The consolidation method is discussed in detail below.

[0020] The laminate 10 may be used in any application requiring a soft, stretchable, breathable material, and especially well suited for disposable articles given its relatively low cost. Suitable applications include, for example, absorbent articles, including adult, child or infant incontinent products (diapers, including parts such as diaper ears, tabs, and/or side panels, briefs, etc.); wraps, including sterile and nonsterile (e.g. bandages with and without absorbent sections,) as well as other disposable and/or multiple use products; e.g., articles proximate to a human or animal body, such as (e.g., garments, apparel, including undergarments, under-and outer-wear, for example, undershirts, bras, briefs, panties, etc., bathing suits, overalls, socks, head coverings and bands, hats, mitten and glove liners, medical clothing, etc.) bed sheets; medical drapes; packaging materials; protective covers; household; office; medical or construction materials; wrapping materials; etc. therapeutic devices and wraps.

[0021] The method of making the laminate is described below with reference to Fig. 2. Figure 2 shows elastic source 20 for providing elastic film 60. In this embodiment, the elastic source 20 comprises a slot die or blown die for extruding molten or semimolten elastic material or coextruding multiple layer film structure in which one or more of the layers are elastic. It should be understood, however, that any conventional elastic source may be used, including, for example, a roll of elastic material.

[0022] The first nonwoven source 70 provides the first nonwoven 50. In this embodiment, the first nonwoven source 70 comprises a roll of material, however, any suitable source may be used, including forming the material *in situ.*

[0023] The first nonwoven 50 is brought into contact with elastic film 60 and bonded thereto. In this embodiment, the molten or semimolten phase of elastic film 60 facilitates bonding with the first nonwoven 50. The first nonwoven 50 may also be bound, in whole or part, to the elastic layer using other conventional methods, such as hot pin aperturing, adhesive bonding, thermal bonding, ultrasonic bonding, and combination thereof.

[0024] Optionally, the elastic film 60 is modified to render it breathable. One preferred approach for aperturing the elastic layer is shown in Fig. 2 in which a pressure differential source 30 is used. Specifically, the first nonwoven 50 and the elastic film 60 are provided to pressure differential source 30 such that the elastic film 60 is interposed between the pressure differential source 30 and the first nonwoven 50. Pressure differential source 30 creates a pressure differential across the thickness of the laminate which is high enough to cause ruptures (i.e., apertures) in the elastic film 60. This method creates three-dimensional apertures which are especially preferred where breathability or permeability of the laminate is desired.

[0025] The pressure differential source 30 is well known. In a preferred embodiment, the pressure differential source 30 comprises a vacuum (not shown) and an aperture definition device 120. In this embodiment, aperture definition device 120 comprises a screen with 20 apertures per linear inch in a square pattern, referred to herein as 20 square. Other screen geometries may be used to vary the amount of open area, aperture size, geometries, patterns, and other attributes. Furthermore, more than one aperture definition device may be used, for example, a device in one area may provide one pattern of apertures, and a device in another area may provide another desired pattern.

[0026] In certain embodiments, it may be desired to modify the elastic layer to make it breathable before it is bonded to the first nonwoven layer. Furthermore, it may preferable to use other known aperturing techniques such as pin rolls, slitting, hydrojets, or lasers, instead of or in addition to a pressure differential source to impart permeability or breathability to the laminate. It should also be understood that modifying the elastic film to render it breathable is not required if the elastic film comprises elastic strands or scrim in which case it is already breathable.

[0027] Pressure source 35 provides pressure to the materials. A nip roll is used in the preferred embodiments, although any suitable source may be used as a pressure source. Additionally, some embodiments may dispense with a pressure source, or use a pressure differential source as a pressure source as well. Moreover, pressure source 35 is shown here upstream of the pressure differential source, although it may be located adjacent to the pressure differential source 30 or down stream of the pressure differential source 30.

[0028] Once the elastic layer is bound to the first nonwoven, it is activated. Referring back to Fig. 2, the laminate 65 is activated in an activation area 40. The activation area 40, in a preferred embodiment, involves intermeshing gear ("IMG") activation, although any conventional activation technique may be used. In the embodiment shown in Fig. 2, activation occurs in the transverse or cross direction (CD), although activation may be in any direction desired, e.g., machine direction (MD), diagonally, or a combination of directions. Further, activation may occur along the entire laminate or only in predetermined areas of the laminate. In other embodiments, the degree of activation may be varied, for example, a lightly activated area may be used to give a laminate low elasticity, while a heavily activated area may be used to give a laminate high elasticity. Of course, activated regions may be interposed with nonactivated regions as well, to provide zones or regions of extensibility to the laminate.

[0029] Returning now to the embodiment of Figure 1, second nonwoven source 80 provides a second nonwoven 55. In this embodiment, the second nonwoven source 80 comprises a roll of material, although any suitable nonwoven source may be used, such as forming the material *in situ.*

[0030] In one embodiment, the second nonwoven 55 is consolidated on-line. Consolidation may be performed using various techniques such as heat consolation, cold drawing, or combing. Preferably, heat consolidation is used which is disclosed, for example, in US Patent No. RE 35,206, which is hereby incorporated by reference. As shown in Fig. 2, the second nonwoven 55 passes through heat application area 45, where heat is applied, and the fibers of the web are oriented in the machine direction, thereby providing for elongation in the cross direction. Although consolidation is performed on-line in this embodiment, it should be understood that the consolidation may be performed ahead of time, and a source of consolidated nonwoven be provided to the line.

[0031] The consolidated nonwoven 91 is brought into contact with activated laminate 75 through rollers 81 and 82 and bonded using known techniques. Preferably, the consolidated nonwoven 91 and laminate 75 are bonded ultrasonically in the ultrasonic bonding area 85. It has been found that this bonding can be performed quickly at normal line speeds, e.g., 70 mpm.

[0032] Varying the materials and method conditions may vary the characteristics of the laminate. For example, selection of particular elastic and/or nonwovens, or selective processing of those materials, can result in optimization of desired properties such as bond strength, softness, elasticity, breathability, etc. Examples of method variables that may be used to modify laminate characteristics include modifying the phase of the elastic layer prior to bonding; modifying the pressure differential applied by a pressure differential source; modifying pressure imposed by a pressure source; modifying apertures in a nonwoven; modifying apertures provided in an aperture definition device; various secondary treatments of the laminate and/or components of the laminate (e.g. plasma treatment), modifying stretching of a laminate following lamination, and combinations thereof. A laminate may also be modified in any suitable fashion, for example, a laminate may be sewn, bonded, printed, cut, shaped, glued, fluted, sterilized, etc.

[0033] Although the present invention has been described with respect to various specific embodiments, various modifications will be apparent from the present disclosure and are intended to be within the scope of the following claims.

Claims

1. A method for forming an elastic laminate comprising:

    bonding a first nonwoven to an elastic film to form a laminate;
    activating said laminate to form an activated laminate; and
    bonding a consolidated nonwoven to said elastic film of said activated laminate to form said elastic laminate.

2. The method of claim 1, wherein said elastic film is apertured.

3. The method of claim 2, wherein said elastic film is bonded to said first nonwoven and apertured essentially simultaneously.

4. The method of claim 3, wherein said first nonwoven and said elastic film are apertured essentially simultaneously.

5. The method of claim 3, wherein vacuum lamination is used to bond said first nonwoven to said elastic film and to aperture said elastic film.

6. The method of claim 2 wherein the elastic film is apertured after the first bonding step.

7. The method of claim 2, wherein the elastic film is apertured before the first bonding step.

8. The method of any one of the preceding claims, wherein activating said laminate comprises activating said laminate in the cross direction.

9. The method of claim 8, wherein said laminate is activated using intermeshing gear activation.

10. The method of any one of the preceding claims, wherein said consolidated nonwoven is extensible in said cross direction.

11. The method of any one of the preceding claims, wherein at least one of said bonding steps comprises ultrasonic bonding.

12. The method of claim 11, wherein said bonding of said consolidated nonwoven is performed ultrasonically.

13. The method of any one of the preceding claims, wherein said bonding of said consolidated nonwoven is performed at essentially the same line speed as said activation step.

14. An elastic laminate comprising:

    an elastic layer having a first side and a second side;
    an activated nonwoven layer bonded to said elastic layer on said first side; and
    a consolidated nonwoven layer bonded to said elastic layer on said second side.

15. The elastic laminate of claim 14, wherein said elastic layer is breathable.

16. The elastic laminate of claim 15, wherein said elastic layer is apertured.

17. The elastic laminate of any one of claims 14 to 16, wherein said activated nonwoven layer is a carded nonwoven.

18. The elastic laminate of claim 17, wherein said activated nonwoven layer is polypropylene.

19. The elastic laminate of any one of claims 14 to 18, wherein said activated nonwoven layer is extensible in a first direction, and said consolidated nonwoven layer is extensible in said first direction.

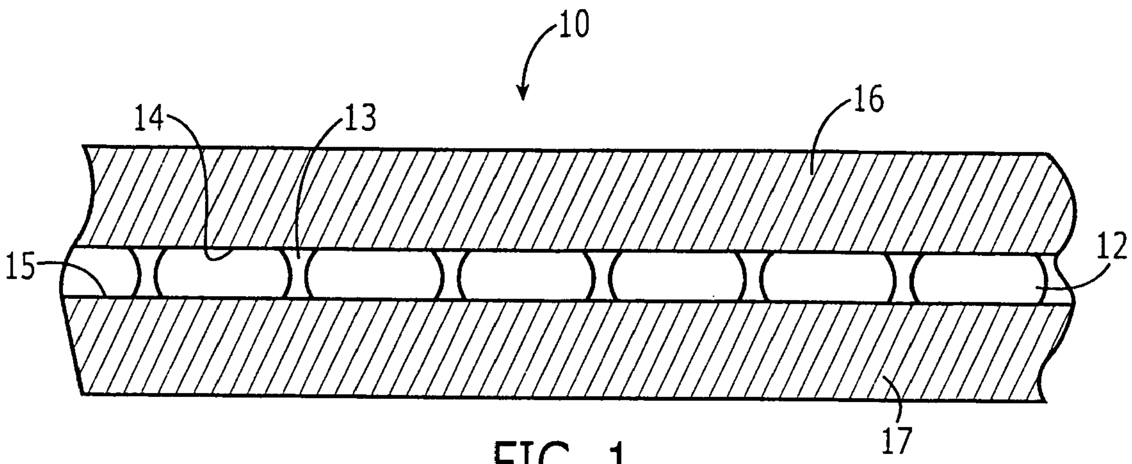
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FIG. 1

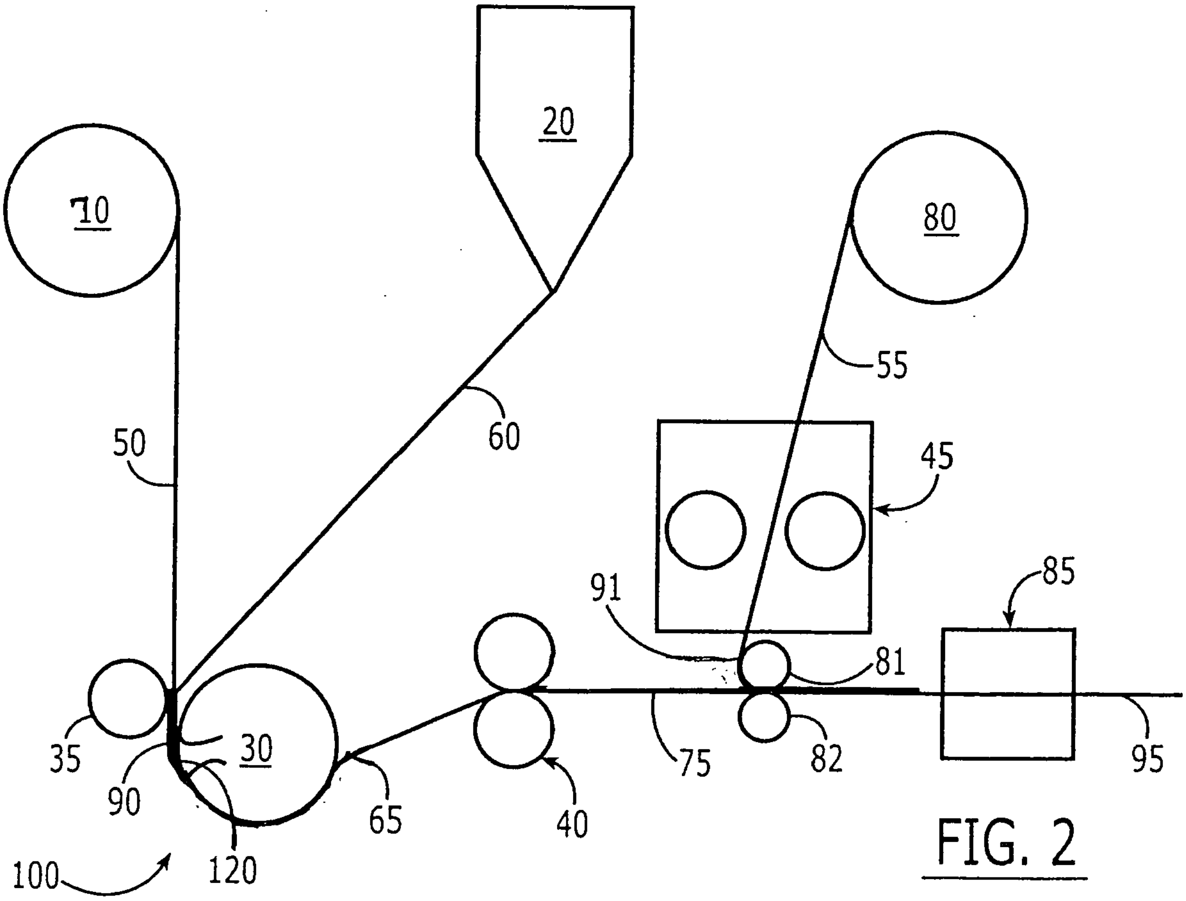
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FIG. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 06 25 6082

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 01/87592 A (TREDEGAR FILM PROD CORP [US]) 22 November 2001 (2001-11-22) * page 2, line 16 - page 3, line 9 * * page 3, line 27 - page 5, line 7 * * page 7, line 27 - page 8, line 7 * * claims 1,2,7,10,12,13 * -----	1-19	INV. B32B5/08 B32B37/14 ADD. B32B5/04 D04H13/00
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A61F
D04H
B32B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	20 March 2007	Girard, Sarah

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 06 25 6082

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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